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Reactions of 4-benzoyl-1,5-diphenyl-1*H*-pyrazole-3-carboxylic acid chloride with various hydroxylamines and carbazates

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The 1*H*-pyrazole-3-carboxylic acid **2** was converted via reactions of its acid chloride **3** with various hydroxylamine **4a-f** and carbazate derivatives **8a-c** into the corresponding novel *N*-substituted-4-benzoyl-1,5-dipenyl-1*H*-pyrazole-3-carboxamides **5a-c**, *N*, *N*-disubstituted-4-benzoyl-1,5-diphenyl-1*H*-pyrazole-3-carboxylates **6d**,**e**, 4-benzoyl-*N*-{[(4-benzoyl-1,5-diphenyl-1*H*-pyrazol-3-yl)carbonyl]oxy}-*N*-methyl-1,5diphenyl-1*H*-pyrazole-3-carboxamide (**7**), and 4-benzoyl-*N*′-(alkoxycarbonyl)-1,5-diphenyl-1*H*-pyrazole-3-carbohydrazides **9a**,**b** and **10**, respectively, in good yields (65%-90%). The reactions of **3** with **4** and **8** in xylene for 8-15 h with catalytic amounts of base led to the formation of the products **5-7**, **9**, and **10**. The structures of all new synthesized compounds were established by the ^{13}C-NMR, ^{1}H-NMR, IR spectroscopic data, and elemental analyses.

Key Words: Pyrazole-3-carboxylic acid, nucleophilic substitution, furan-2,3-dione, carbazate, hydroxylamine

Introduction

Furan-2,3-diones in general are considered convenient and versatile synthons in heterocyclic synthesis.[1,2] A convenient method for their synthesis, the mechanism of reactions, and semi-empirical (AM1 and PM3) and ab initio (DFT) calculations on the interaction of 4-benzoyl-5-phenyl-2,3-dihydro-2,3-furandione (**1**) with several semicarbazones, ureas, thioureas, and anilides have been reported recently.[3−7] The reactions of the furan-2,3-dione **1** and various hydrazines or hydrazones result in new pyrazole-3-carboxylic acids, pyrazolopyridazinones, and

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some of their derivatives. The pyrazole carboxylic acids can be easily transformed into the corresponding acid chloride, ester, or amide derivatives by the general chemical procedures.[8–12] Pyrazoles belong to one of the most important classes of heterocyclic compounds, which are very significant for medicinal chemistry.[13–18] Molecules of many modern drugs, e.g., antiphlogistic, antifungal, antidiabetic, and analgesic, as well as of insectoacaricides used in practice, contain a pyrazole ring as a structural fragment.[19–28] In view of these important properties, we decided both to prove the reproducibility of the reaction of 4-benzoyl-1,5-diphenyl-1*H*-pyrazole-3-carboxylic acid chloride (**3**) with some hydroxylamine, **4**, and carbazate, **8**, derivatives and to extend our investigations related to preparing new heterocycles, which include the pyrazole ring in their structure. We herein report the synthesis and characterization of *N*-substituted 4-benzoyl-1,5-dipenyl-1*H*-pyrazole-3-carboxamides **5a-c**, *N*, *N*-disubstituted-4-benzoyl-1,5-diphenyl-1*H*-pyrazole-3-carboxylates **6d**,**e**, 4-benzoyl-*N*-{[(4-benzoyl-1,5-diphenyl-1*H*-pyrazol-3-yl)carbonyl]oxy}-*N*-methyl-1,5-diphenyl-1*H*-pyrazole-3-carboxamide (**7**) (see Scheme 1), 4-benzoyl-*N′*-(alkoxycarbonyl)-1,5-diphenyl-1*H*-pyrazole-3-carbohydrazides **9a**,**b**, and 4-benzoyl-*N′*-[(4-benzoyl-1,5-diphenyl-1*H*-pyrazol-3-yl)carbonyl]-1,5-diphenyl-1*H*-pyrazole-3-carbohydrazide (**10**) by the reaction of the pyrazole-3-carboxylic acid chloride **3** with the corresponding hydroxylamine **4a-f** and carbazate derivatives **8a-c** (see Scheme 2).

Experimental

Melting points are uncorrected and were recorded on an Electrothermal 9200 digital melting point apparatus. Microanalyses were performed on a Leco-932 CHNS-O Elemental Analyzer. A Shimadzu FT-IR-8400 model spectrophotometer was used for IR spectra (in the range of 400-4000 cm^{-1} region), using ATR techniques. The ^{1}H- and ^{13}C-NMR spectra were measured with a Bruker Avance III 400 MHz spectrometer and the chemical shifts were recorded in ppm units. After completion of the reactions, solvents were evaporated with a rotary evaporator (Buchi RE model 111). The reactions were followed by TLC using DC Alufolien Kieselgel 60 F_{254} Merck and a Camag TLC lamp (254/366 nm). Solvents and all other chemical reagents were purchased from commercial suppliers and were of reagent grade quality. Solvents were dried by refluxing with the appropriate drying agents and distilled before use.

General procedure for the synthesis of compounds 5-10

Appropriate amounts of the acid chloride **3** (0.50 g, 1.30 mmol) and the corresponding hydroxylamine, **4**, or carbazate, **8**, derivatives (molar ratio 1:1 or 1:2) were dissolved in xylene and refluxed together with catalytic amounts of pyridine for 8-15 h. Then the solution was cooled to room temperature and the corresponding reaction products **5-7**, **9**, and **10** were obtained after evaporation of the solvent and triturating with diethyl ether or petroleum ether. After suction filtration, the crude products were recrystallized from ethanol and dried on P_2O_5.

4-Benzoyl-*N*-benzyloxy-1,5-diphenyl-1*H*-pyrazole-3-carboxamide (5a):

Compound **5a** was prepared according to the general procedure with a reflux time of 10 h (*O*-benzylhydroxylamine) resulting in 79% yield (0.48 g); mp 182 °C. FT IR (ATR, cm^{-1})ν: 3179 (N-H), 3050 (arom. C-H), 2950

(aliph. C-H), 1652, 1638 (C=O), 1589, 1583, 1502, 1446 (phenyl and pyrazole rings C···C, C···N). ^{1}H-NMR (400 MHz, DMSO-d_6)δ: 12.00 (br, 1H, NH), 8.00-7.24 (m, 20H, ArH), 4.80 ppm (s, 2H, CH_2). ^{13}C-NMR (100 MHz, DMSO-d_6)δ: 190.82 (PhC=O), 158.72 (-NC=O) 144.32 (C-5), 143.75 (C-3), 138.94, 138.15, 136.10, 133.70, 130.12, 129.68, 129.53, 129.46, 129.23, 129.13, 128.96, 128.87, 128.70, 128.20, 128.04, 126.43, 126.07, 121.95 (C-Ph), 77.46 ppm (CH_2). *Anal.* calcd. for $C_{30}H_{23}N_3O_3$ (473.52 g/mol); C, 75.80; H, 9.14; N, 4.61. Found: C, 75.40; H, 8.86; N, 4.87.

4-Benzoyl-*N*-methoxy-*N*-methyl-1,5-diphenyl-1*H*-pyrazole-3-carboxamide (5b):

Compound **5b** was prepared according to the general procedure with a reflux time of 8 h (*N*,*O*-dimethylhydroxylamine) resulting in 90% yield (0.45 g); mp 170 °C. FT IR (ATR, cm^{-1})ν: 3042 (arom. C-H), 2928, 2881 (aliph. C-H), 1659, 1639 (C=O), 1593, 1582, 1510, 1445 (phenyl and pyrazole rings C···C, C···N). ^{1}H-NMR (400 MHz, $CDCl_3$) δ: 7.90-7.20 (m, 15H, ArH), 3.81 (s, 3H, CH_3), 3.30 ppm (s, 3H, CH_3). ^{13}C-NMR (100 MHz, $CDCl_3$)δ: 190.06 (PhC=O), 146.93 (-NC=O), 144.19 (C-5), 138.97, 138.28, 132.49, 130.34, 129.32, 129.15, 128.89, 128.46, 128.28, 128.24, 128.17, 128.04, 125.40 (C-Ph), 61.03 (OCH_3) 29.59 ppm (NCH_3). *Anal.* calcd. for $C_{25}H_{21}N_3O_3$ (411.45 g/mol): C, 72.98; H, 5.14; N, 10.21. Found: C, 73.29; H, 5.05; N, 9.88.

4-Benzoyl-*N*-(4-nitrobenzyloxy)-1,5-diphenyl-1*H*-pyrazole-3-carboxamide (5c):

Compound **5c** was prepared according to the general procedure with a reflux time of 12 h (*O*-(4-nitrobenzyl)hydroxylamine) resulting in 76% yield (0.51 g); mp 197 °C. FT IR (ATR, cm^{-1})ν: 3200 (N-H), 3055 (arom. C-H), 2953 (aliph. C-H), 1665, 1636 (C=O), 1600, 1578, 1514, 1442 (phenyl and pyrazole rings C···C, C···N). ^{1}H-NMR (400 MHz, DMSO-d_6)δ: 10.85 (1H, NH), 7.90-6.99 (m, 19H, ArH), 5.40 ppm (s, 2H, CH_2). ^{13}C NMR (100 MHz, DMSO-d_6)δ: 192.00 (PhC=O), 159.20 (-NC=O), 149.60 (C-5), 147.62 (C-NO_2), 147.22, 146.68, 144.17, 143.86, 139.14, 133.69, 130.33, 129.71, 129.58, 129.45, 128.96, 128.70, 128.48, 128.13, 126.47, 123.79, 118.69 (C-Ph), 76.06 ppm (CH_2). *Anal.* calcd. for $C_{30}H_{22}N_4O_5$ (518.52 g/mol); C, 69.49; H, 4.28; N, 10.81. Found: C, 69.80; H, 4.25; N, 10.59.

N,N-Dimethylamino 4-benzoyl-1,5-diphenyl-1*H*-pyrazole-3-carboxylate (6d):

Compound **6d** was prepared according to the general procedure with a reflux time of 12 h (*N*,*N*-dimethylhydroxylamine) resulting in 77% yield (0.41 g); mp 198 °C. FT IR (ATR, cm^{-1})ν: 3068 (arom. C-H), 2978 (aliph. C-H), 1698, 1678 (C=O), 1589, 1512, 1494, 1442 (phenyl and pyrazole rings C···C, C···N). ^{1}H-NMR (400 MHz, $CDCl_3$)δ: 7.98-7.10 (m, 15H, ArH), 2.60 ppm (s, 6H, CH_3). ^{13}C-NMR (100 MHz, $CDCl_3$)δ: 191.26, (PhC=O), 162.71 (-OC=O), 143.41 (C-5), 142.96, 139.07, 138.10, 133.86, 130.07, 129.69, 129.55, 129.50, 129.22, 129.09, 128.88, 128.22, 126.27, 123.25 (C-Ph), 40.01 ppm (CH_3). *Anal.* calcd. for $C_{25}H_{21}N_3O_3$ (411.45 g/mol): C, 72.98; H, 5.14; N, 10.21. Found: C, 73.16; H, 4.94; N, 10.00.

N,N-Dibenzylamino 4-benzoyl-1,5-diphenyl-1*H*-pyrazole-3-carboxylate (6e):

Compound **6e** was prepared according to the general procedure with a reflux time of 15 h (*N*, *N*-dibenzylhydroxylamine) resulting in 79% yield (0.34 g); mp 202 °C. FT IR (ATR, cm^{-1})ν: 3049 (arom. C-H), 2938 (aliph. C-H), 1696, 1643 (C=O), 1544, 1514, 1498, 1443 (phenyl and pyrazole rings C···C, C···N). ^{1}H-NMR (400 MHz, DMSO-d_6)δ: 7.80-7.10 (m, 25H, ArH), 4.00 ppm (s, 4H, CH_2). ^{13}C-NMR (100 MHz, DMSO-d_6)δ: 192.17, (PhC=O), 164.49 (-OC=O), 149.85 (C-5), 141.97, 141.08, 139.65, 138.96, 135.51, 133.06, 131.21, 130.44, 129.92, 129.41, 129.29, 129.21, 129.11, 129.06, 128.90, 128.81, 128.75, 128.50, 128.41, 127.94, 127.52, 127.24, 126.68, 125.92, 125.34, 122.84 (C-Ph), 64.40 ppm (CH_2). *Anal.* calcd. for $C_{37}H_{29}N_3O_3$ (563.65 g/mol); C, 78.84; H, 5.19; N, 7.46. Found: C, 78.86; H, 5.15; N, 7.50.

4-Benzoyl-*N*-{[(4-benzoyl-1,5-diphenyl-1*H*-pyrazol-3-yl)carbonyl]oxy}-*N*-methyl-1,5-diphenyl-1*H*-pyrazole-3-carboxamide (7):

Compound **7** was prepared according to the general procedure with a reflux time of 15 h (*N*-methylhydroxylamine) resulting in 67% yield (0.48 g); mp 156 °C. FT IR (ATR, cm^{-1})ν: 3057 (arom. C-H), 2980 (aliph. C-H), 1773, 1707, 1658 (C=O), 1585, 1545, 1457 (phenyl and pyrazole rings C···C, C···N). ^{1}H-NMR (400 MHz, DMSO-d_6)δ: 7.90-7.08 (m, 30H, ArH), 2.20 ppm (s, 3H, CH_3). ^{13}C-NMR (100 MHz, DMSO-d_6)δ: 190.91, 190.48 (PhC=O), 160.10 (-OC=O), 159.90 (-NC=O), 143.82, 143.73 (C-5, C-5'), 142.57, 139.57, 139.16, 138.64, 138.10, 137.75, 133.43, 132.78, 130.06, 129.95, 129.83, 129.72, 129.49, 129.36, 129.14, 129.09, 128.83, 128.62, 128.46, 128.43, 128.22, 128.09, 127.87, 127,50, 125.66, 125.48, 125.09, 124.31, 124.18 (C-Ph), 29.03 ppm (CH_3). *Anal.* calcd. for $C_{47}H_{33}N_5O_5$ (747.80 g/mol); C, 75.49; H, 4.45; N, 9.37. Found: C, 75.18; H, 4.71; N, 9.33.

4-Benzoyl-*N'*-(ethoxycarbonyl)-1,5-diphenyl-1*H*-pyrazole-3-carbohydrazide (9a):

Compound **9a** was prepared according to the general procedure with a reflux time of 10 h (ethyl carbazate) resulting in 75% yield (0.32 g); mp 128 °C. FT IR (ATR, cm^{-1})ν: 3261 (N-H), 3057 (arom. C-H), 2984 (aliph. C-H), 1734, 1691, 1666 (C=O), 1593, 1550, 1491, 1450 (phenyl and pyrazole rings C···C, C···N). ^{1}H-NMR (400 MHz, $CDCl_3$)δ: 9.65 (s, 1H, NH), 8.92 (s, 1H, NH), 7.90-7.00 (m, 15H, ArH), 4.21 (q, 2H, CH_2), 1.34 ppm (t, 3H, CH_3). ^{13}C-NMR (100 MHz, $CDCl_3$)δ: 191.35 (PhC=O), 159.97, 156.08 (NC=O), 144.08 (C-5), 142.99 (C-3), 138.78, 133.18, 129.82, 129.51, 129.31, 129.08, 128.61, 128.29, 127.79, 125.39, 125.31, 122.34 (C-Ph), 62.25 (CH_2), 14.33 ppm (CH_3). *Anal.* calcd. for $C_{26}H_{22}N_4O_4$ (454.48 g/mol); C, 68.71; H, 4.88; N, 12.33. Found: C, 68.73; H, 4.87; N, 12.36.

4-Benzoyl-*N'*-(benzyloxycarbonyl)-1,5-diphenyl-1*H*-pyrazole-3-carbohydrazide (9b):

Compound **9b** was prepared according to the general procedure with a reflux time of 12 h (benzyl carbazate) resulting in 70% yield (0.27 g); mp 137 °C. FT IR (ATR, cm^{-1})ν: 3268 (N-H), 3058 (arom. C-H), 2986 (aliph. C-H), 1739, 1694, 1667 (C=O), 1596, 1552, 1491, 1447 (phenyl and pyrazole rings C···C, C···N). ^{1}H-NMR (400 MHz, DMSO-d_6)δ: 10.32 (s, 1H, NH), 9.30 (s, 1H, NH), 7.80-7.08 (m, 20H, ArH), 5.06 ppm (s, 2H, CH_2). ^{13}C-

NMR (100 MHz, DMSO-d_6)δ: 191.34 (PhC=O), 160.53, 156.63 (NC=O), 144.18 (C-5), 142.93 (C-3), 139.03, 138.07, 133.73, 130.03, 129.69, 129.52, 129.49, 129.24, 128.98, 128.90, 128.80, 128.30, 128.23, 126.40, 122.42 (C-Ph), 68.00 ppm (CH_2). *Anal.* calcd. for $C_{31}H_{24}N_4O_4$ (516.55 g/mol); C, 72.08; H, 10.85; N, 4.68. Found: C, 72.07; H, 10.84; N, 4.70.

4-Benzoyl-*N'*-[(4-benzoyl-1,5-diphenyl-1*H*-pyrazol-3-yl)carbonyl]-1,5-diphenyl-1*H*-pyrazole-3-carbohydrazide (10):

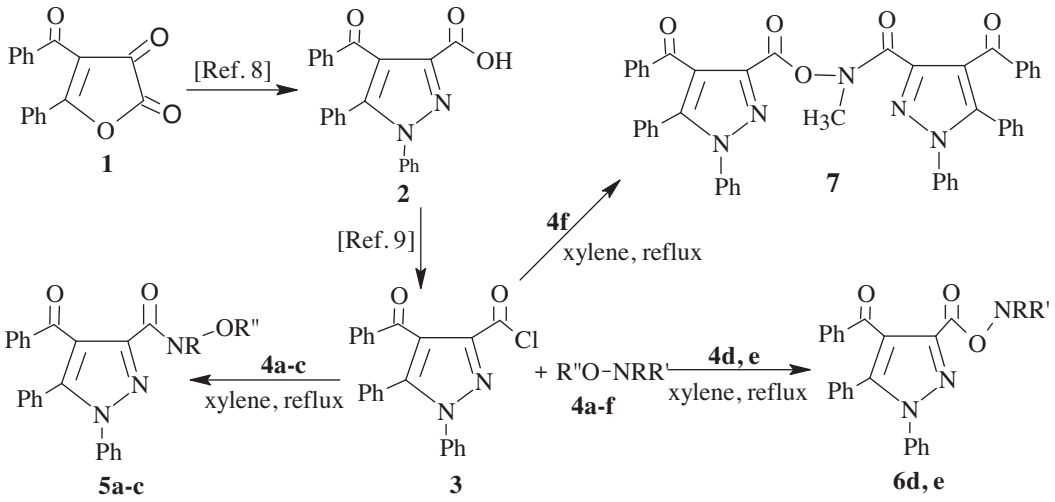
Compound **10** was prepared according to the general procedure with a reflux time of 8 h (*tert*-butyl carbazate) resulting in 65% yield (0.50 g); mp 193 °C. FT IR (ATR, cm^{-1})ν: 3167, 3120 (N-H), 3022 (arom. C-H), 2941, 2897 (aliph. C-H), 1664, 1620 (C=O), 1595, 1537, 1488, 1452 (phenyl and pyrazole rings C···C, C···N). ^{1}H-NMR (400 MHz, DMSO-d_6)δ: 10.32 (s, 2H, NH), 7.92-7.00 (m, 30H, ArH). ^{13}C-NMR (100 MHz, DMSO-d_6)δ: 191.19 (PhC=O), 160.01 (NHC=O), 143.83 (C-5), 143.33 (C-3), 139.04, 138.10, 133.68, 130.02, 129.68, 129.51, 129.46, 128.90, 128.25, 126.33, 122.40 ppm (C-Ph). *Anal.* calcd. for $C_{46}H_{32}N_6O_4$ (732.78 g/mol); C, 75.40; H, 4.40; N, 11.47. Found: C, 75.38; H, 4.42; N, 11.47.

Results and discussion

Treatment of the yellow furandione **1** with phenylhydrazine under reflux in benzene for 3 h yielded the corresponding white 1*H*-pyrazole-3-carboxylic acid **2**.[8] Compound **2** can easily be transformed into the 1*H*-pyrazole-3-carboxylic acid chloride **3** by usual chemical procedures.[9] Substituted furan-2,3-dione **1**, -acid **2** and -acid chloride **3**, which were used as important initial materials in the synthesis of the target heterocycles, were prepared using the literature procedures (Scheme 1).[1,8,9,29]

The reaction of compound **3** with various hydroxylamines **4** and carbazates **8** in the presence of a catalytic amount of pyridine proceeded rapidly by refluxing in xylene and was completed after 8-15 h to afford the corresponding carboxamide, carboxylate, and carbohydrazide derivatives **5-7**, **9**, and **10** in good yields (65%-90%), without opening the pyrazole ring. In order to make the reaction selective, we had to determine the parameters, in other words the reaction pathways, leading to such results. The excellent yield of the reaction can be explained by the chemical behavior of compound **3** towards H-active nucleophiles, such as hydroxylamines and carbazates. It should start with a nucleophilic attack of the nitrogen and/or oxygen atoms' lone pair electrons of the hydroxylamine to the antibonding (π^*) orbital at the carbonyl carbon at C-3 position of the pyrazole ring. The new products **5-7**, **9**, and **10** obtained arise followed by the elimination of hydrogen chloride. Although we have not studied this issue further, we assume that the reaction occurs under thermodynamic control. The byproducts formed this way are removed when the raw products are treated with diethyl ether. Previously, analogous reactions and their mechanisms have been reported with hydrazines, ureas, diamines, aminophenols, thiosemicarbazides, and the corresponding open chain compounds.[9–17] The structure of compound **5a**, which was obtained in 79% yield in the first experiment, was established by spectral data, in particular by the presence of carbonyl (benzoyl and amidic) characteristic bands of **5a** (FT IR: 1652 s, 1638 s. cm^{-1}). The broad absorption of N-H group was at 3179 cm^{-1},[30] and absorption bands of various intensity were observed in the spectra of **5a** assigned to skeleton bands of benzene or pyrazole rings, together

with N-H bending vibrations, at 1589-1446 cm^{-1}. In the ^{1}H-NMR spectra, the NH protons resonated at 12.00 ppm as a broad singlet integrating for one proton. Moreover, proton signals due to the OCH_2 group of this compound resonated at 4.80 ppm as a singlet integrating for the 2 protons. Different aromatic protons were found in the usual range (at 8.00-7.24 ppm). In the ^{13}C-NMR spectrum of **5a**, the characteristic signal belonging to carbonyl carbon appeared at 190.82 (benzoyl) and 158.72 ppm (amidic). Complete ^{13}C-NMR data are given in the Experimental part. These results are in full agreement with a similar finding with substituted 1*H*-pyrazole-3-carboxamides and -3-carboxylates.[8−16,25,26]

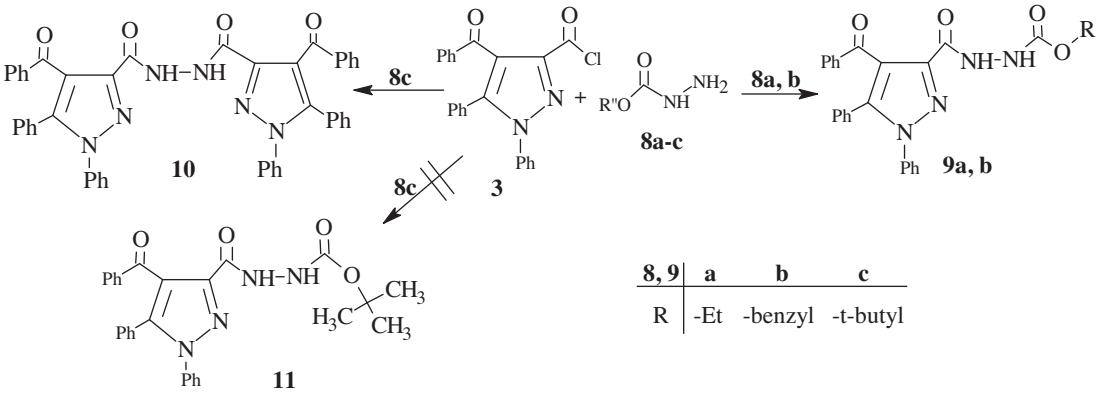


4-6	a	b	c	d	e	f
R	-H	$-CH_3$	-H	$-CH_3$	$-CH_2Ph$	$-CH_3$
R'	-H	-H	-H	$-CH_3$	$-CH_2Ph$	-H
R''	$-CH_2Ph$	$-CH_3$	$-CH_2Ph-NO_2$	-H	-H	-H

Scheme 1. Synthetic pathway for the preparation of compounds **3**-**7**.

Interaction of the pyrazole-3-carboxylic acid chloride **3** with **4d**,**e** at reflux results in the corresponding new compounds **6d**,**e**, in good yields (77% and 79%, respectively). Surprisingly, using *N*,*N*-disubstituted hydroxylamine derivatives **4d**,**e** in reactions with **3**, the 1*H*-pyrazole-3-carboxylates **6d**,**e** were obtained exclusively. In addition, the reaction of **3** with *N*-methyl hydroxylaminehydrocloride (**4f**) in refluxing xylene, together with catalytic amounts of pyridine afforded 4-benzoyl-*N*-{[(4-benzoyl-1,5-diphenyl-1*H*-pyrazol-3-yl)carbonyl]oxy}-*N*-methyl-1,5-dipheny-1*H*-pyrazole-3-carboxamide (**7**). The moderate to good yield of the reactions can be explained by the chemical behavior of acid chlorides, similar to the behavior of the compound **3** towards *O*- and *N*−nucleophiles.[9−15] The formation of **7** can easily be explained by a nucleophilic attack on the carbonyl groups of 2 molecules of the acid chloride **3**. It appears that this process can be followed by elimination of 2 molecules of hydrogen chloride to give **7**, whose formation is confirmed by TLC using authentic specimens of **7** and strongly supported by the results of analytical as well as spectroscopic measurements. The IR spectrum of **7** showed characteristic absorption bands at 1773, 1707, and 1658 cm^{-1} for carbonyl groups (ester, amidic, and benzoyl). The ^{1}H-NMR signals were observed at δ 7.90-7.08 ppm (m, ArH) and 2.20 ppm (s, CH_3) and

the ^{13}C-NMR signals at δ 190.91, 190.48 (benzoyl), 160.10 (ester), 159.91 (amide), 143.73, 143.82 (C-5, C-5'), 142.57-124.18 (arom. C's), and 29.03 ppm (CH_3).



Scheme 2. Synthesis of substituted 1*H*-pyrazole-3-carbohydrazide derivatives **9**, **10**.

4-Benzoyl-*N'*-(ethoxycarbonyl)-1,5-diphenyl-1*H*-pyrazole-3-carbohydrazide **9a** was synthesized by the reaction of ethyl carbazate (**8a**) and the compound **3**, which could be obtained by the elimination of hydrogen chloride (see Scheme 2). The structures of the compounds **9** were confirmed from IR and ^{1}H- and ^{13}C-NMR spectroscopic data. The IR spectrum of **9a** exhibited ester and amidic carbonyls at 1734 and 1691 cm^{-1}. The ^{1}H-NMR spectrum showed singlets at 9.65 and 8.92 ppm due to NH protons. The aromatic protons resonated as multiplets in the range of 7.90-7.00 ppm. Further confirmation also came from ^{13}C-NMR data (for details see the Experimental). However, analytical and spectroscopic investigations clearly indicated that the reaction of compound **3** with *tert*-butyl carbazate gave the new product **10** instead of the expected 4-benzoyl-*N'*-(*tert*-butoxycarbonyl)-1,5-diphenyl-1*H*-pyrazole-3-carbohydrazide **11**. In this reaction, *tert*-butyl carbazate behaved as a binucleophile. It is assumed that this chemical behavior and the comparatively low yields could be attributed to the steric hindrance of *tert*-butyl group. *tert*-Butyl carbazates are less reactive because bulky groups present a strong hindrance to the approaching substrate. Furthermore, the *tert*-butoxycarbonyl group is a weak base and good leaving group. Thus, the *tert*-butyl substituent is very bulky and used in chemistry for kinetic stabilization together with other bulky groups. The effect that the *tert*-butyl group exerts on the progress of a chemical reaction is called the *tert*-butyl effect. This effect is illustrated in many reactions, where the *tert*-butyl substituent causes a reaction rate acceleration by compared to hydrogen as the substituent.[31,32] Therefore, addition of *tert*-butyl carbazate binucleophile to the acid chloride **3** usually starts with nucleophilic attack at the acid chloride moieties in compound **3**. Therefore, the new product **10** obtained arises from the sequential attacks of the carbazate at the acid chloride moieties of 2 respective molecules of **3**, followed by the elimination of hydrogen chloride.[11] The IR spectra of the compound **10** showed characteristic absorption bands at 3167, 3120 cm^1 (N-H) and 1664, 1620 cm^1 (C=O). The structure of compound **10** was evidenced by the disappearance of *tert*-butyl protons in ^{1}H-NMR spectra and appearance of 2 NH protons at 10.32 ppm as a singlet. The values of the elemental analysis were found to be in good agreement ($\pm$0.3%) with the calculated values.

Conclusions

In this study, we have developed convenient preparative procedures for the efficient synthesis of previously unknown pyrazole-3-carboxamides and pyrazole-3-carboxylates derivatives. The above approach has been proved very useful for the construction of novel heterocycles of potential pharmacological interest. The newly synthesized compounds attract interest as potential biologically active substance, as well as precursors and reagents for the design of complex polyfunctional structures.

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